Education and training in nuclear engineering in the Czech Republic

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Although the number of nuclear scientists and technologist may appear to be sufficient today in some countries, there are indicators, e. g. declining university enrollment, changing industry personnel profiles, dilution of university course content, and high retirement expectation, that future expertise is a risk. The need to preserve, enhance or strengthen nuclear knowledge is worldwide recognized since a couple of years. Today, the priorities of the scientific community regarding basic research lie elsewhere than in nuclear sciences. Many of the highly competent engineers and, who helped create the present nuclear industry, and its regulatory structure, are approaching retirement age. These competence issues need to be addressed at Community level and a well designed Community research and training program should play a role is a more important than ever before. Czech Nuclear Education Network CENEN is a voluntary academic association of educational institution offering teaching and training in the area of Nuclear Engineering. It is striving to develop and maintain a high standard of Czech nuclear education and to reach its integration into the all-European context. CENEN was established in Prague on May 2005, in the framework program the European Commission supports the European Nuclear Engineering Network ENEN.

Keywords: Electric Power Engineering, Nuclear Power Plants, Nuclear Radiochemistry, Radiation Chemistry, Nuclear Reactors, Synchronous Generators, Transformer and Electric Machines.

I. INTRODUCTION

The economy and economies around the world continue to grow, the need for abundant energy resources will also grow. Nuclear energy is safe, environmental clean, reliable and affordable. The Czech Republic will work to develop advanced nuclear technologies, new recycling processes, reduce waste and minimize sources fossil fuels. Nuclear power doesn't rely on imported fossil fuels, and as nuclear energy becomes increasingly used for power generation, other energy resources, like natural gas, could be directed to other essential uses such as home heating and manufacturing. Nuclear power is capable of meeting increasing world demand for energy without emitting air pollution or greenhouse gasses.

II. EUROPEAN MAST OF SCIENCE IN NUCLEAR ENGINEERING [EMSNE]

Based upon a year-long exchange of views between the partners of nuclear academic institution and research laboratories of the EU, a coherent and practicable concept, for a EMSNE has emerged. The concept is compatible with the Bologna philosophy of higher education for academic engineers in Europe. The curriculum leading to the degree of MSNE is composed of course units formally recognized by ENEN. A minimum of two semesters equivalent must be obtained in strictly nuclear subjects composed of a set of core-curriculum courses complemented with nuclear electives and a project-work in a nuclear domain. The ENEN and CENEN network consist of effective and associated members. The effective members are academic institutions providing high level scientific education in the nuclear field. The associated members have a firmly established tradition of relations with members in the field of nuclear education, research and training.

III. EDUCATION AND TRAINIG ON THE TRAINIG REACTOR VR - 1

The program called Teaching, Training and Experiments on training reactor VR-1 enables students to improve their knowledge in the sphere of nuclear reactions and their usage in nuclear power engineering. The experiments performed on the training reactor are very similar to the processes carried out in huge energetic reactor and that is why the workers of nuclear power plants can also use the training reactor to get prepared their work. The power engineering graduates, particularly those, who studied the nuclear power plant branch, can find a good job quite easily, and moreover, it is a possible to say that the interest of this branch has been still increasing. Nuclear energy utilization closely follows Czech requirements and international recommendation for nuclear safety, radiation protection and physical protection. Both requirements and the recommendations activate demands on personnel training in the field of nuclear energy. With the VR-1 reactor, Czech nuclear scientist can benefit from its training and experimental potential. Also, university students from the entire Czech republic train on the VR-1 rector.

The VR-1 training nuclear reactor is a pool-type, light-water reactor based on enriched uranium. The neutron moderator is light water, which is also used as reflector, biological shielding and coolant. Heat is removed from the core with natural convection. There are two pools in the reactor, the first is designed for the reactor core, and the other one is a handling and experimental vessel. A waterproof gate can disconnect the two vessels. The handling vessel is equipped with storage space for fuel assemblies, and can be used to prepare experiments. The reactor has operated several experimental devices two horizontal, radial and tangential channels used to take out a neutron beam. The control rods have a integral function, they differ only in function and their connection to the control equipment. The outer neutron source is used to start up the reactor.

Nuclear safety is in the condition and the ability of theVR-1 reactor and its personnel to prevent both uncontrolled development of a fission chain reaction and the unacceptable release of radioactive substances or radiation into the environment. Radiation protection is a system of both technical and organizational measures to limit exposure to people and the environment. Physical protection is a system of measures preventing unauthorized activities nuclear installation, nuclear materials and selected items. Generally research and experimental reactor don't produce electricity, but they are important neutron source for different uses - medicine, industry and research.

USE OF THE VR-1 REACTOR

The reactor is a operated particularly for the training of university students and nuclear power plant personnel. Training on the reactor provides students with experience in reactor and neutron physic, nuclear safety and nuclear installation operation. Currently, students can go through more than 22 experimental exercises, many study materials have been prepared.

The following is a list of some of the experiments performed on the reactor VR-1:

-Properties of neutron detectors for nuclear reactor control
-Measurement of delayed neutrons
-Determinations of the effect of various materials on the reactivity of the reactor
-Measurement of thermal neutron flux density
-Measurement of reactivity by various methods
-Calibrations of control rods
-Approach to the critical state
-Study of nuclear reactor dynamic
-Start-up and operation of the VR-1 reactor
-Studying the influence of the bubbly boiling to the reactivity
-Gamma spectroscopy and Neutron Activation Analyses
-Various experiments of reactor operation

Scientific research respecting reactor parameters and requirements of the so-called reactor core-free from major effect of the fission product.

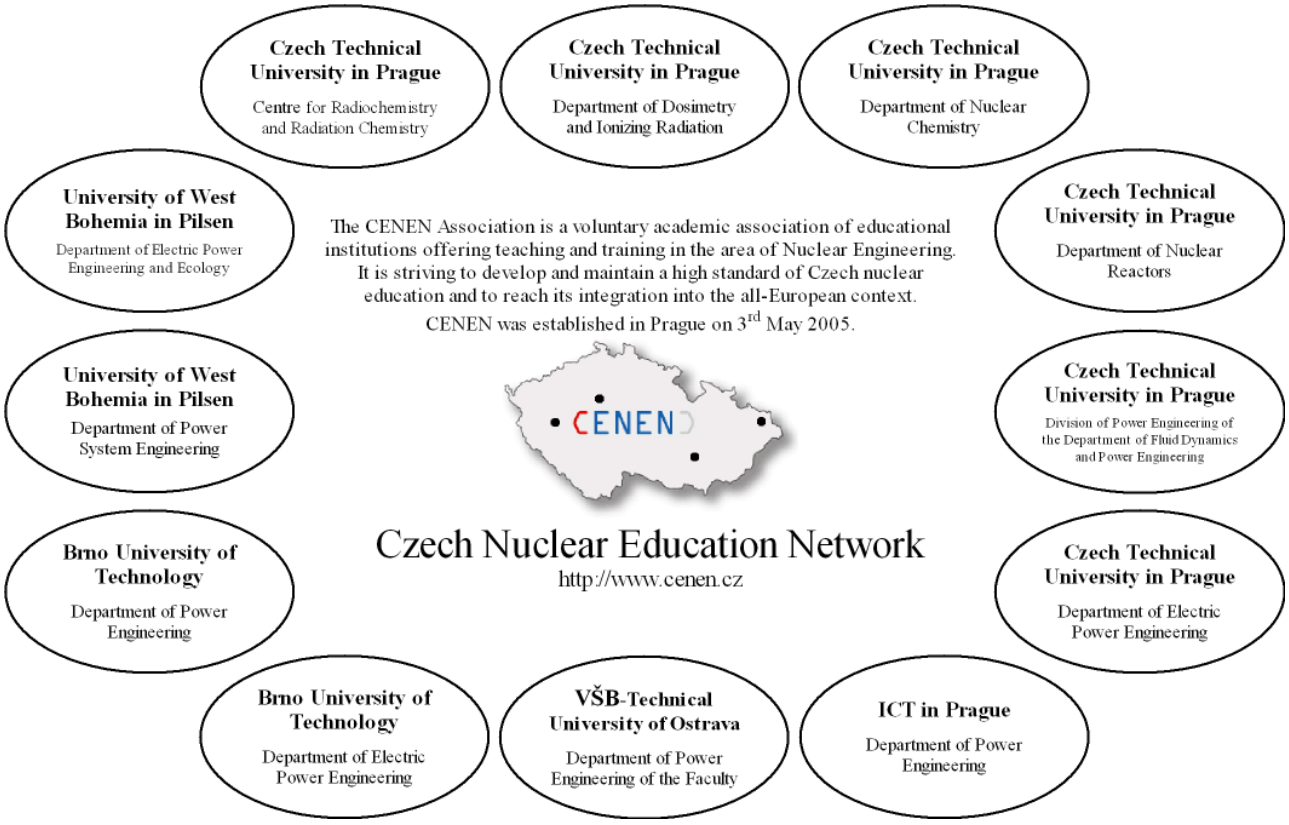

Figure 1. CENEN Association - The Network of University Institutes dealing nuclear engineer education

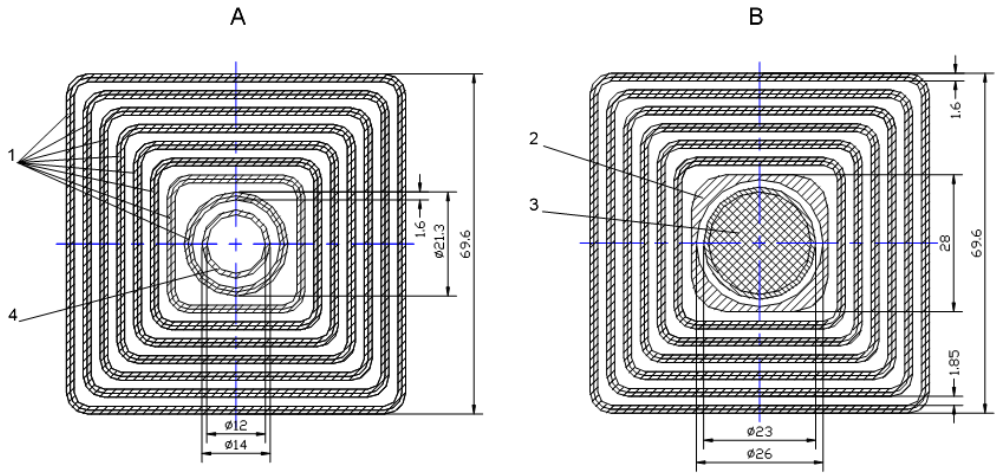

Figure 2. The IRT-4M type FA cross section, A – 8-tube FA, B – 6-tube FA
1 – fuel elements; 2 – channel of control rod; 3 - control rod; 4 – central displacement tube

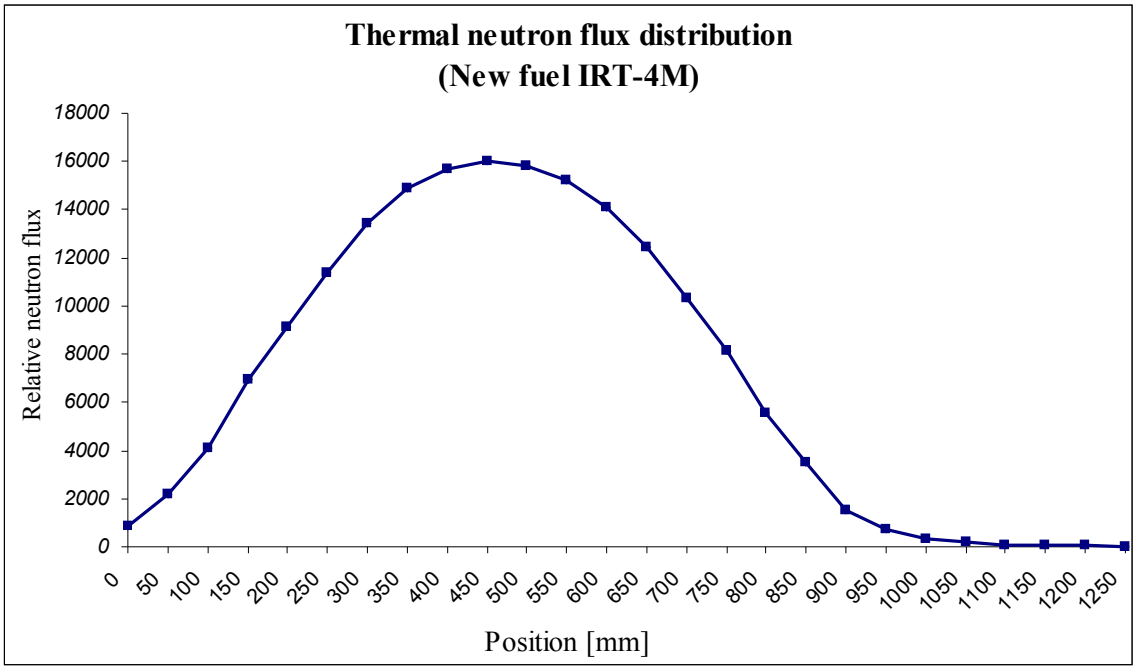

Figure 3. Thermal neutron flux distribution in the reactor core VR-1 Sparrow with new fuel IRT-4M